Preregistration and Registered Reports

Tools for improving the transparency and reproducibility of biomedical research

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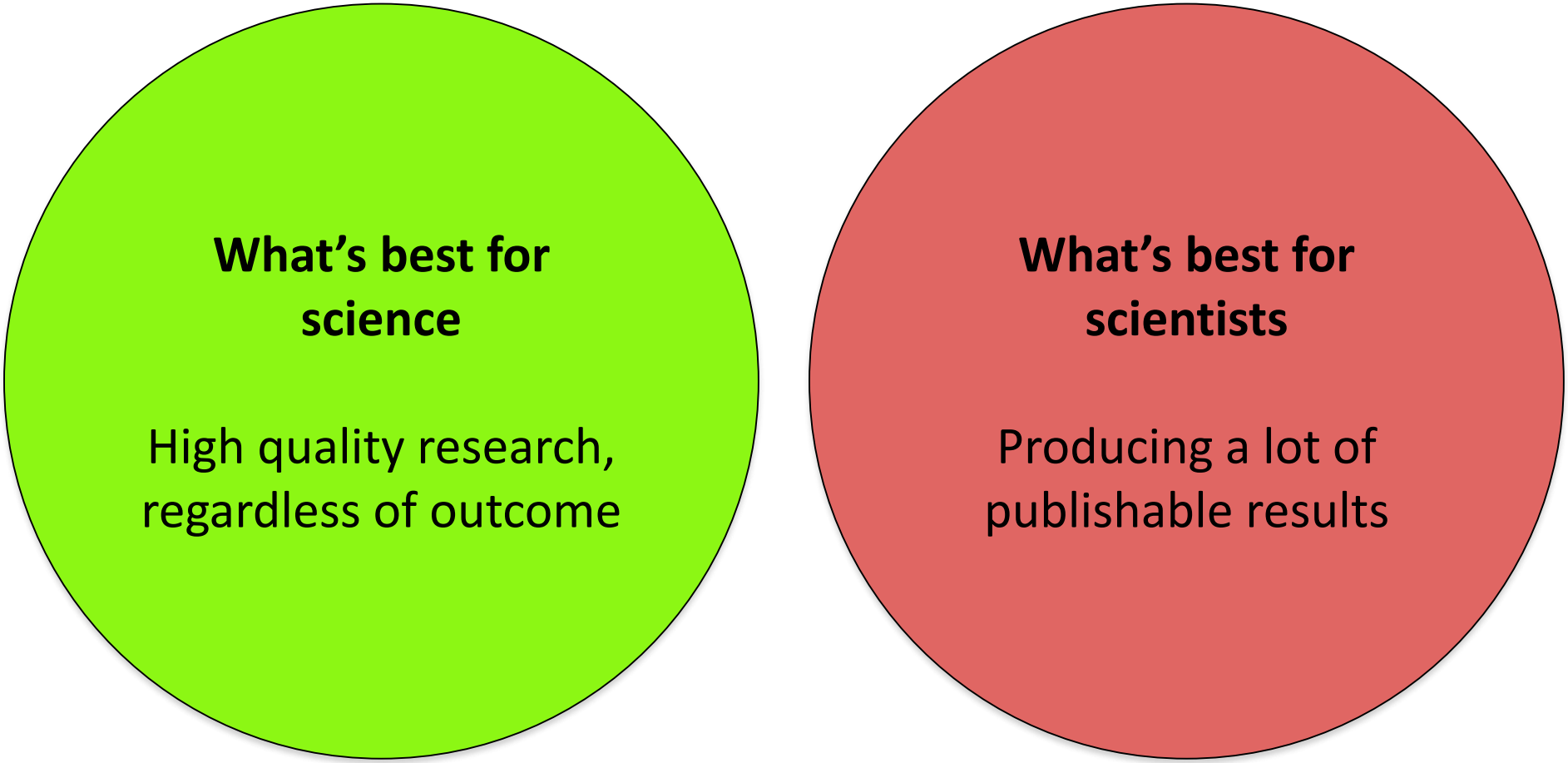
Two main messages for today

1. We are reviewing papers the **wrong way** and it has corrupted the incentive structure in science

2. Study preregistration and **Registered Reports** can help fix this problem

Science has an incentive problem



see Nosek, Spies & Motyl (2012). *Perspectives on Psychological Science, 7(6)*: 615–631

What happens when researchers are pressured to get publishable results?

Publication bias – *suppression of negative or complex findings*

Significance chasing – *"p-hacking", selective reporting*

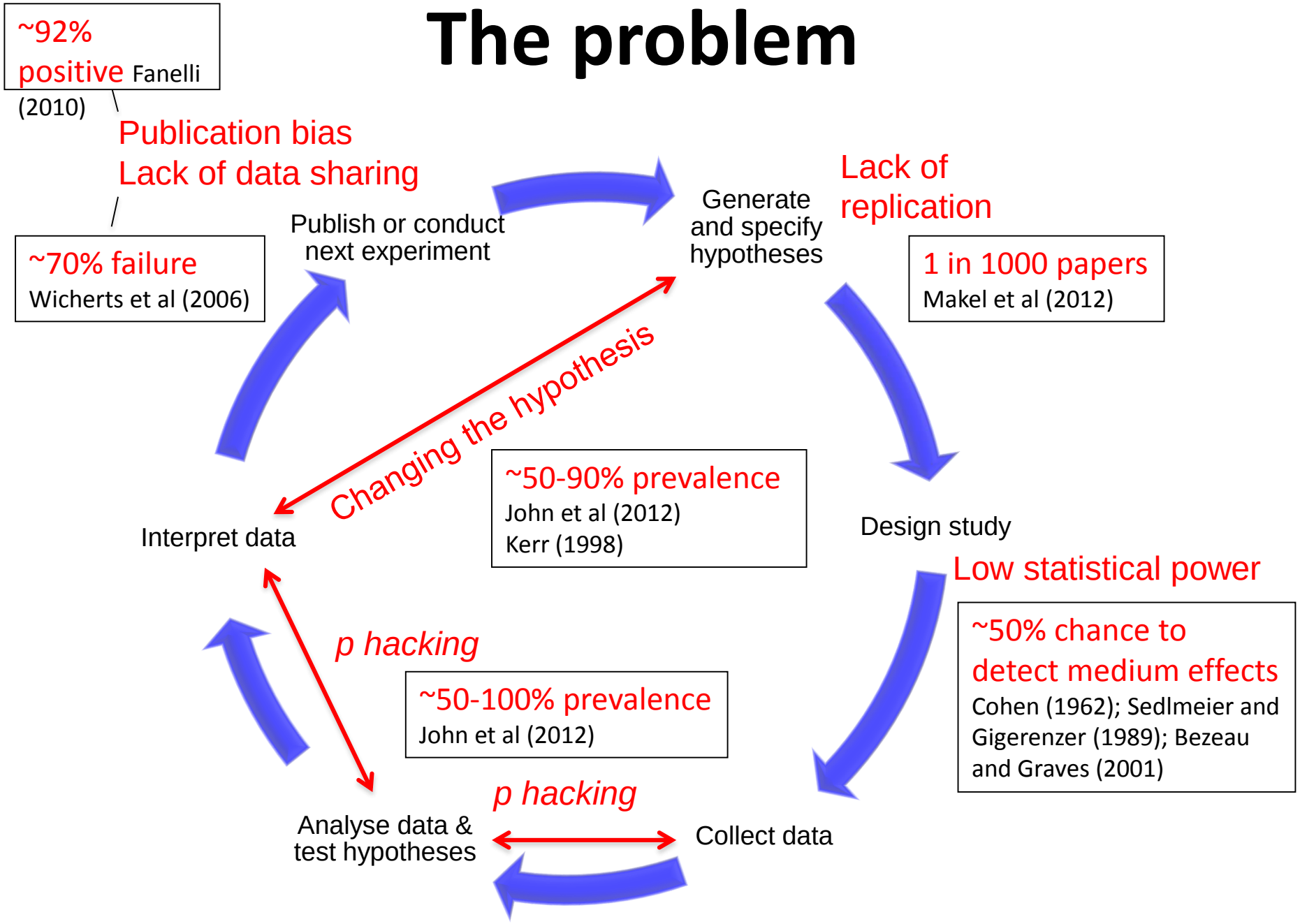
Changing the hypothesis to fit the results – *hypothesizing after results are known (HARK)*

Lack of data sharing – *no time, too hard, no incentive*

Low statistical power – *quantity of papers over quality*

Lack of replication – *seen as boring, lacking in intellectual prowess*

The problem


~92% positive Fanelli (2010)
Publication bias
Lack of data sharing
~70% failure
Wicherts et al (2006)
Publish or conduct next experiment
Generate and specify hypotheses
Lack of replication
1 in 1000 papers
Makel et al (2012)
Changing the hypothesis
~50-90% prevalence
John et al (2012)
Kerr (1998)
Interpret data
Design study
Low statistical power
~50% chance to detect medium effects
Cohen (1962); Sedlmeier and Gigerenzer (1989); Bezeau and Graves (2001)
p hacking
~50-100% prevalence
John et al (2012)
p hacking
Analyse data & test hypotheses
Collect data

Why is this happening?

Because we place too much importance on the **results** of experiments and not enough on the **processes** that produce them

Results make science exciting but judging the quality of science (and scientists) according to the results is “soft” science

Can we fix this? Yes

Philosophy:

What gives hypothesis-testing its scientific value is

- the QUESTION it asks
- the QUALITY of the method it uses
- never the RESULT it produces

If we accept this philosophy then editorial decisions at journals should be *blind* to results

The first principle is that you must not fool yourself – and you are the easiest person to fool.

- Richard Feynman

Registered Reports

CORTEX 49 (2013) 609–610

Available online at www.sciencedirect.com

SciVerse ScienceDirect

Journal homepage: www.elsevier.com/locate/cortex

Editorial

Registered Reports: A new publishing initiative at *Cortex*

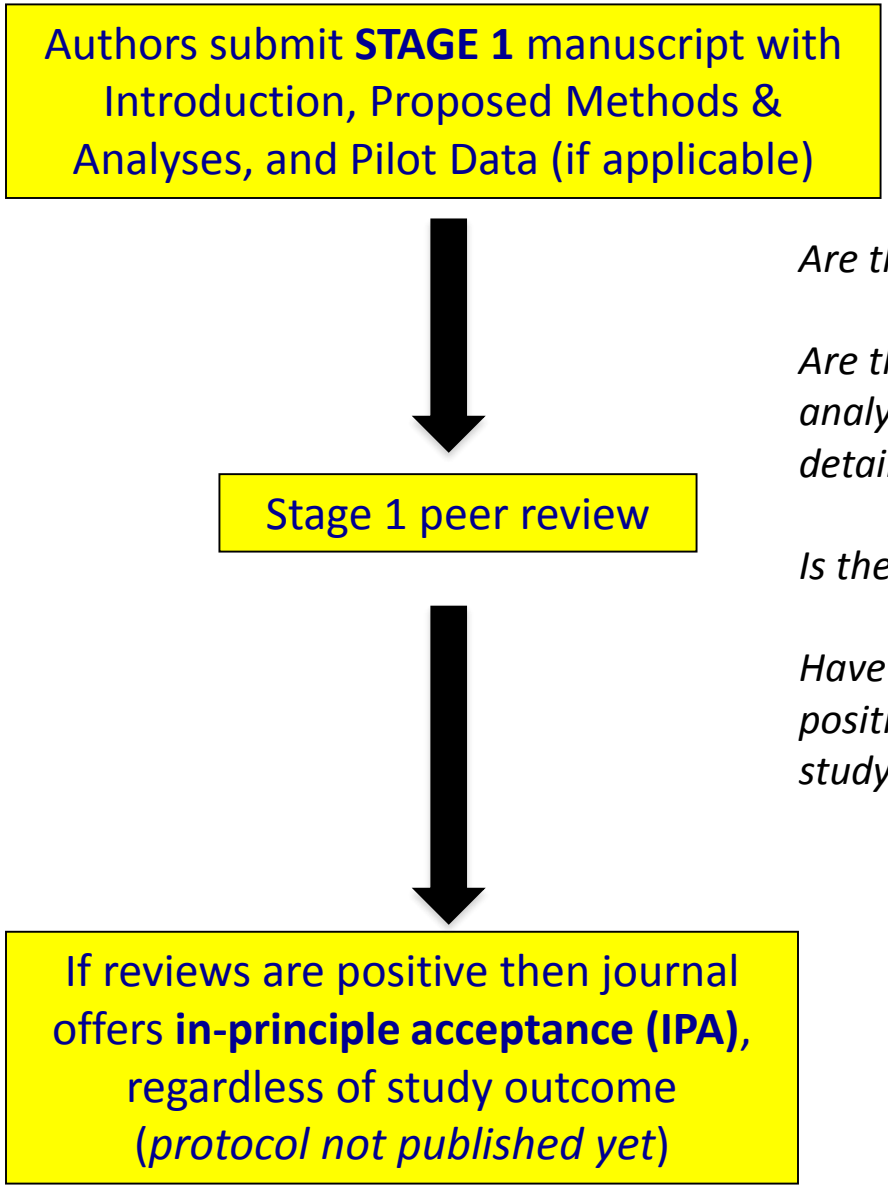
Christopher D. Chambers

Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, United Kingdom

Four central aspects of the Registered Reports model:

- Researchers decide hypotheses, experimental procedures, and main analyses *before* data collection
- Part of the peer review process takes place before experiments are conducted
- Passing this stage of review virtually guarantees publication
- Original studies and high-value replications are welcome

How it works



Are the hypotheses well founded?

Are the methods and proposed analyses feasible and sufficiently detailed?

Is the study well powered? (≥90%)

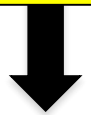
Have the authors included sufficient positive controls to confirm that the study will provide a fair test?

How it works

Authors do the research

Authors resubmit completed **STAGE 2** manuscript:

- **Introduction** and **Methods** (virtually unchanged)
- **Results (new)**: Registered confirmatory analyses + unregistered exploratory analyses
- **Discussion (new)**
- **Data deposited in a public archive**



Stage 2 peer review

Manuscript published!

Did the authors follow the approved protocol?

Did positive controls succeed?

Are the conclusions justified by the data?

None of these things matter

Some published examples at Cortex

Registered report

The effects of AMPA blockade on the spectral profile of human early visual cortex recordings studied with non-invasive MEG

Suresh D. Muthukumaraswamy [a,b,], Bethany Routley [c], Wouter Droog [d], Krish D. Singh [c] and Khalid Hamandi [c,e]*

Registered report

Role of features and categories in the organization of object knowledge: Evidence from adaptation fMRI

Jingyi Geng and Tatiana T. Schnur[*]

Registered report

The functional subdivision of the visual brain: Is there a real illusion effect on action? A multi-lab replication study

Karl K. Kopiske [a,f,], Nicola Bruno [b], Constanze Hesse [c], Thomas Schenk [d] and Volker H. Franz [a,e]*

Registered report

Using EEG and stimulus context to probe the modelling of auditory-visual speech

Tim Paris[*], Jeesun Kim and Chris Davis

Registered report

Mu suppression – A good measure of the human mirror neuron system?

Hannah M. Hobson[*] and Dorothy V.M. Bishop

Registered report

The P600 as a correlate of ventral attention network reorientation

Jona Sassenhagen [a,c,] and Ina Bornkessel-Schlesewsky [b,a]*

http://www.journals.elsevier.com/cortex/virtual-special-issues/virtual-special-issue-registered-reports

See also:

Social Psychology special issue: http://econtent.hogrefe.com/toc/zsp/45/3

Perspectives on Psychological Science: http://www.psychologicalscience.org/index.php/replication/ongoing-projects

A few FAQS

1. Are Registered Reports suitable for all sciences?

- Applicable to any field engaged in hypothesis-driven research where one or more of the following problems apply:
  - **Publication bias**
  - **Significance chasing**
  - ***Post hoc* hypothesizing (hindsight bias, HARKing)**
  - **Low statistical power**
  - **Lack of direct replication**
  - **Lack of data sharing**

- Not applicable for
  - **Purely exploratory science**
  - **Methods development**

} No hypothesis testing

A few FAQS

2. How are Registered Reports different from other forms of preregistration, such as in clinical trials?

- Guaranteed publication of the outcomes prevents publication bias
- Rigorous peer review of the protocol prevents vague specification of statistical methods or study variables, e.g. outcome measures
- Continuity of peer review between protocol and published paper ensures that the protocol is part of the final paper

Prevents 'hidden outcome switching' and other forms of researcher bias, e.g. Ben Goldacre et al http://compare-trials.org/

Ramagopalan S, Skingsley AP, Handunnetthi L et al. Prevalence of primary outcome changes in clinical trials registered on ClinicalTrials.gov: a cross-sectional study [version 1; referees: 3 approved]. F1000Research 2014, 3:77

67	9	354	357
TRIALS CHECKED	TRIALS WERE PERFECT	OUTCOMES NOT REPORTED	NEW OUTCOMES SILENTLY ADDED

On average, each trial reported just 58.2% of its specified outcomes. And on average, each trial silently added 5.3 new outcomes.

A few FAQS

3. How long does the review process take?

- At Cortex:
  - ~8-10 weeks to complete Stage 1 review, not including time taken for authors to revise manuscript
  - ~2-4 weeks to complete Stage 2 review

4. What is the acceptance rate?

- For standard (unregistered) research articles, the rejection rate is 90%
- For Registered Reports, only 10% of submissions that pass editorial triage (and proceed to in-depth Stage 1 review) are rejected

5. Are Registered Reports suitable for early career researchers?

- **YES** – they send a clear signal that you're a scientist who cares about transparency and reproducibility; not just "playing the game" but seeking to make real discoveries
- Going for post doc jobs, what you do think will look better on your CV?

  A) Bunch of papers listed as "in preparation", "submitted", "submitted to *Nature*"

  B) Bunch of papers listed as "provisionally accepted at *[Journal]*"

A few FAQS

6. "What's to stop researchers from 'pre-registering' a study that they have already conducted?"

- Time-stamped raw data files must be submitted at Stage 2 with basic lab log and certification from all authors that data was collected after provisional acceptance
- Submitting a completed study at Stage 1 would therefore be fraud
- Strategy would backfire anyway when reviewers ask for protocol amendments
- *Registered Reports are not an anti-fraud measure*

7. "What's to stop Registered Reports from becoming a dumping ground for inconclusive null results?"

- *a priori* power requirements (≥90%) increase reproducibility of all findings
- Bayesian methods welcomed (B<0.33 or B>3 for substantial evidence). A specialist Bayes editor has been appointed at *Cortex* (Zoltan Dienes)

8. "Won't this limit the exploration or serendipitous findings?"

- The are **no restrictions** on the reporting of unregistered exploratory analyses.
- Confirmatory and exploratory analyses will simply be labeled correctly

Challenges of Registered Reports

Ethics committees

- Managing possible back-and-forth between Ethics Committee and journal at Stage 1

Compatibility with timeline of student research

- Possible solution: Daisy Chain model in which student spends their final year undergraduate project on two simultaneous (or near simultaneous) tasks:
    - Preparing and submitting a detailed Stage 1 RR; including experience of peer review process; intensive training in deductive hypothesis testing
    - Implementing the provisionally accepted Stage 1 RR submitted by the *previous* year's student

Compatibility with limited samples sizes of much student research

- Solution: consortia-based undergraduate projects

Instilling scientific rigour at the grassroots

A letter from our March edition advocates consortium-based undergraduate projects.

March 2016
Vol.29 (pp.158-167)

Related articles

> Methods: Improving the student participant experience
> The emperor's new clothes?
> Rehabilitation – writing a new story

Most read

Katherine S. Button
Department of Psychology, University of Bath
Natalia S. Lawrence
Mood Disorders Centre, University of Exeter
Chris D. Chambers
School of Psychology, Cardiff University
Marcus R. Munafò
School of Experimental Psychology, University of Bristol

There is increasing awareness of the problem of unreliable findings across social, psychological and biomedical research. The 'publish or perish' culture, and the bias towards generating novelty and positive results, may incentivise running multiple small studies measuring multiple outcomes. This, combined with flexible analytical procedures, can generate a large number of positive results, but many will be false positive. These positive results are disproportionately rewarded with publication, potentially leading to grant

Going even further…

Can we integrate clinical trial registration, ethical review, grant funding and Registered Reports?

- Possible solution: **Registered Reports funding model**
- Authors submit their research proposal *before* they have funding.
- Following simultaneous review by the both the funder and the journal, the strongest proposals would be offered financial support by the funder AND in-principle acceptance for publication by the journal.

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Trust in science would be improved by study pre-registration

Open letter: We must encourage scientific journals to accept studies before the results are in

Chris Chambers, **Marcus Munafo** and more than 80 signatories
theguardian.com, Wednesday 5 June 2013 12.45 BST

Jump to comments (43)

The quest: a better understanding of nature. Photograph: Sebastian Kaulitzki/Alamy

In an ideal world, scientific discoveries would be independent of what scientists *wanted* to discover. A good researcher would begin with an idea, devise a method to test the idea, run the study as planned, and then decide based on the evidence whether the idea had been supported. Following this approach would lead us step-by-step toward a better understanding of nature.

Unfortunately, the life sciences are becoming increasingly estranged from this way of thinking. Early in their training, students learn that the quest for truth needs to be balanced against the more immediate pressure to

Journals offering Registered Reports:

AIMS Neuroscience
American Journal of Political Science*
American Political Science Review*
American Politics Research*
Attention, Perception & Psychophysics
Cognition & Emotion
Cognitive Research: Principles and Implications
Comparative Political Studies*
Comprehensive Results in Social Psychology
Cortex
Drug and Alcohol Dependence
eLife*
European Journal of Neuroscience
Experimental Psychology
Frontiers in Cognition (a)*
Frontiers in Cognition (b)*
Human Movement Science
International Journal of Psychophysiology
Journal of Accounting Research
Journal of Business and Psychology
Journal of European Psychology Students
Journal of Experimental Political Science
Journal of Media Psychology
Journal of Personnel Psychology
Nature Human Behaviour
Nicotine & Tobacco Research
NFS Journal
Perspectives on Psychological Science
Political Analysis*
Political Behavior*
Political Science Quarterly*
Political Science Research and Methods*
Public Opinion Quarterly*
Royal Society Open Science
Social Psychology*
State Politics and Policy Quarterly*
Stress & Health
The Leadership Quarterly
Working, Aging and Retirement

* Special issue

Registered Reports at *Royal Society Open Science*

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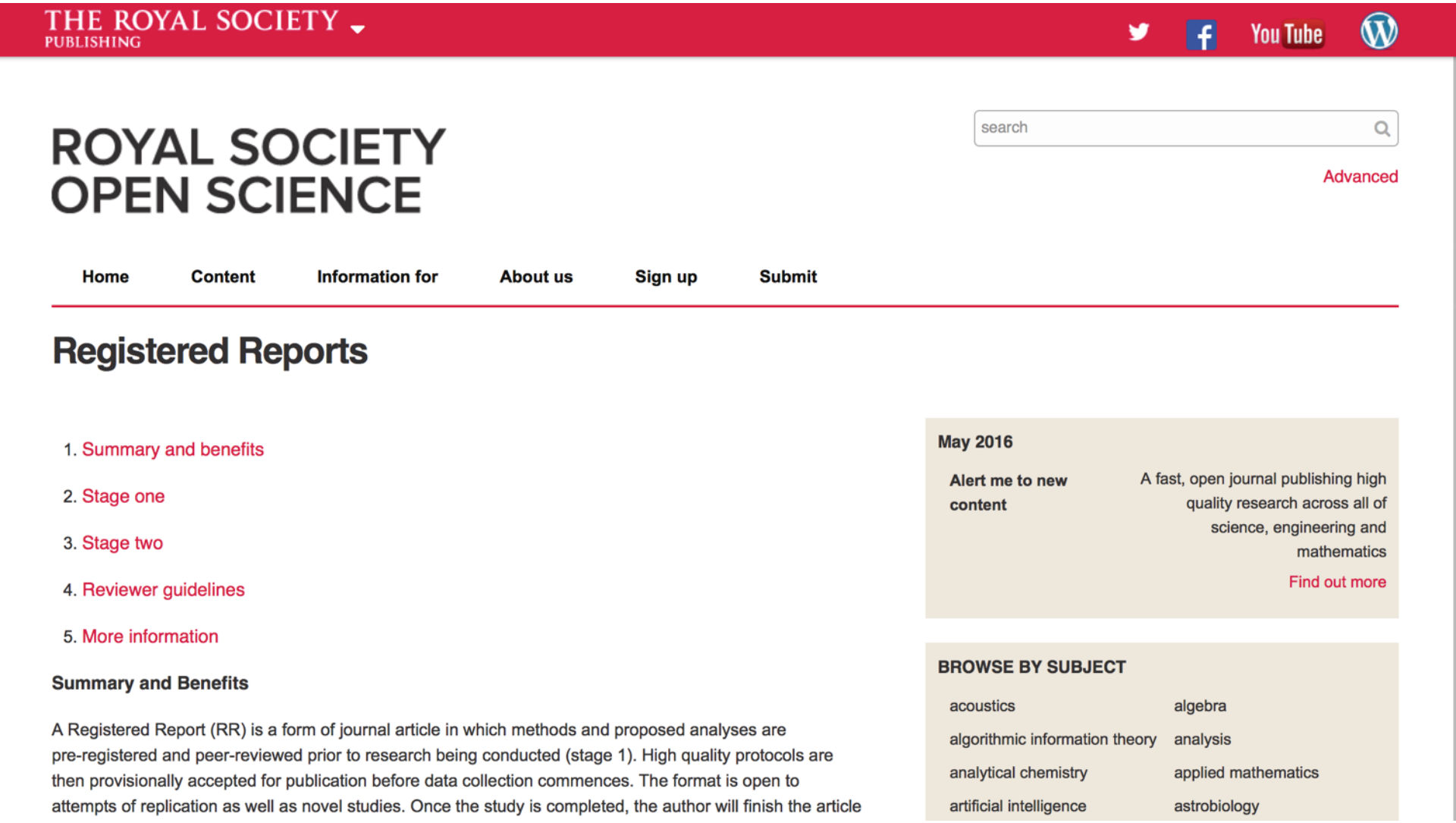

http://rsos.royalsocietypublishing.org/content/registered-reports

Registered Reports at *Nature Human Behaviour*

Disciplines covered in the journal include:

Anthropology	Evolution
Artificial Intelligence	Genetics
Business Studies	Geography
Cognitive Science	Linguistics
Communication	Management
Criminology	Neurology
Cultural Studies	Neuroscience
Ecology	Political Science
Economics	Psychiatry
Education	Psychology
Epidemiology	Public Policy
Ethology	Sociology

Information Hub at the Center for Open Science

Registered Reports

Peer review before results are known to align scientific values and practices

- Registered Reports
- Participating Journals
- Details and Workflow
- Resources for Editors
- Funders
- FAQ
- News

Transparency, open sharing, and reproducibility are core values of science, but not always part of daily practice. Registered Reports are a publication format that emphasize the importance of the research question and the quality of methodology by conducting the peer review prior to data collection and analysis. Accepted papers then are virtually guaranteed publication in the journal if the authors follow through with the registered methodology.

"Registered Reports eliminates the bias against negative results in publishing because the results are not known at the time of review" said Daniel Simons, Professor at University of Illinois, Urbana-Champaign and co-Editor of Registered Replication Reports at Perspectives on Psychological Science. Chris Chambers, Professor at Cardiff University, section editor at Cortex and Royal Society Open Science, and chair of the Registered Reports Committee supported by the Center for Open Science (COS) adds, "Because the study is accepted in advance, the incentives for authors change from producing the most beautiful story to producing the most accurate one."

Two articles provide an introduction to the Registered Reports concept: one is an introduction to a special issue of 15 Registered Reports in Social Psychology (Nosek & Lakens, 2014), the other is an introduction to Registered Reports for AIMS Neuroscience including answers to 25

https://cos.io/rr/

- Detailed FAQs
- Table comparing journal features

Google "registered reports" – top hit

For more info, email me (chambersc1@cardiff.ac.uk) or David Mellor at the COS (david@cos.io)

Acknowledgements

George Banks
Sven Bestmann
Ananyo Bhattacharya
Dorothy Bishop
Sara Bowman
Jon Brock
Kate Button
Toby Charkin
Molly Crockett
Sergio Della Sala
Zoltan Dienes
Tim Errington
Pete Etchells
Agneta Fischer
Andrew Gelman
Alex Holcombe
Macartan Humphreys
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Daniël Lakens
Natalia Lawrence
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Rob McIntosh
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EJ Wagenmakers
Matt Wall
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CENTER FOR OPEN SCIENCE

For further information: https://cos.io/rr/ (Google “registered reports” – top hit)

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